

## SHEET FEEDER IN IMAGE READING APPARATUS

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from JP 2003-070679, filed March 14, 2003, the disclosure of which is incorporated in its entirety herein by reference thereto.

### BACKGROUND OF THE INVENTION

#### 1. Field of Invention

[0002] The invention relates to a sheet feeder that feeds a sheet, such as a document, in an image reading apparatus, and, more particularly, to a structure to prevent image reading failures caused by a sheet to be fed being instantaneously stopped at a reading part when a leading edge of the sheet collides with a roller disposed at a downstream position of the reading part.

#### 2. Description of Related Art

[0003] Conventionally, in a facsimile, scanner or copier, a plurality of documents are stacked at one place, and fed one by one by an auto sheet feeder to read images on the documents at a reading part where a line-type CCD image pickup device or a line-type contact image sensor (CIS) is disposed. In this case, a sheet feeder, which comprises a roller pair, that is, a drive roller and a driven roller used in pair, is provided at a downstream side of the reading part. If axes of the drive roller and the driven roller are set in a direction perpendicular to a sheet feed direction, a nip portion between the drive roller and the driven roller extends in an axial direction of the rollers and is parallel to the direction perpendicular to the sheet feed direction. Thus, at the instant when the leading edge of the sheet collides against the nip portion along the length of the nip portion and width of the sheet, a load at the collision is great, and the feeding of the sheet is instantaneously stopped, resulting in a problem that the movement of images being read on the sheet is disrupted at the reading part and image data can not be accurately obtained.

[0004] On the other hand, when a sheet to be passed through a paper sheet discharging mechanism is not stiff (rigidity is not sufficient), as a structure to reinforce the stiffness, Japanese Laid-Open Patent Publication No. 2001-310857 (FIGS. 1 to 5) discloses a paper sheet discharging mechanism formed of pairs of rollers, which are driving rollers and driven rollers, that press against the driving rollers, for discharging the paper sheets from the inside of the device. Axes of the driven rollers that press the paper sheets to the driving

rollers, that convey the paper sheets in the sheet discharging direction, are disposed on planes parallel to the axes of the driving rollers, and arranged symmetrically with respect to a centerline of the sheets to be discharged and inclined with respect to the axes of the driving rollers.

[0005] According to this structure, the sheets to be discharged are deflected at a center of the width, the deflection continues in the direction of travel, which produces a shape based stiffness in the sheets, thereby making the sheets stiff. Thus, this prevents the sheets from drooping downstream of the roller feeding, and jamming during discharge.

[0006] However, if the sheet feeder, made up of the pairs of the rollers with the structure disclosed in the former publication, is provided at the downstream side of the reading part, the deflection protruding substantially in the center of the document may continue up to the upstream side of the feeding. Thus, the deflection may be curved approaching or going away from the reading part, resulting in the distance from the document to the reading part may change between a part with the deflection and a part without the deflection. Thus, the degree of approach of the document to the reading part in its width direction varies greatly. As a result, image data of correct size cannot be obtained.

#### SUMMARY OF THE INVENTION

[0007] The invention provides a sheet feeder in an image reading apparatus, which is capable of obtaining image data correctly.

[0008] According to exemplary embodiments of the invention, a sheet feeder that feeds a sheet in an image reading apparatus with an image reading part may include a drive roller unit that is disposed at a downstream side from the reading part in a sheet feed direction and includes a drive roller, and a driven roller unit that includes a driven roller that presses against the drive roller. A coefficient of friction of an outer layer of the driven roller to a sheet to be fed may be smaller than a coefficient of friction of an outer layer of the drive roller to the sheet. Further, an axis of the drive roller may be disposed perpendicular to the sheet feed direction, and an axis of the driven roller disposed on a slant with respect to the sheet feed direction.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] An embodiment of the invention will be described in detail with reference to the following figures, wherein:

[0010] FIG. 1 is a perspective view of a multifunction device including a document reader having an auto sheet feeder according to the invention;

[0011] FIG. 2 is perspective view where a cover of the document reader having the auto sheet feeder is open from a main body case;

[0012] FIG. 3 is side sectional view showing essential parts of the document reader having the auto sheet feeder;

[0013] FIG. 4 is a top view of a pair of ejection rollers disposed on a downstream side from a document reading part with respect to a sheet feed direction;

[0014] FIG. 5A is a top view of driven rollers except for drive rollers;

[0015] FIG. 5B is an enlarged perspective view of a guide groove for a support shaft of a driven roller;

[0016] FIG. 5C is an enlarged sectional view taken along line  $V_c-V_c$  of FIG. 5A;

[0017] FIG. 6A is a pictorial view showing a first embodiment of the invention;

[0018] FIG. 6B is a view showing another embodiment of the invention; and

[0019] FIG. 6C is a view showing a further embodiment of the invention.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] An exemplary embodiment of the invention will be described in detail with reference to the accompanying drawings. As shown in FIG. 1, the embodiment is applied to a document reader 2 with an auto sheet feeder 6 in a multifunction device 1 including a facsimile function, a scanner function, a copier function, and a printer function.

[0021] A large-sized glass plate 4 for placing a document thereon is fixed in a horizontal state on a top surface of a main body case 3 of the multifunction device 1. An operation panel portion 5 is provided in a front part of the top surface of the main body case 3. The operation panel portion 5 includes a ten keypad for executing the facsimile function, the scanner function, and the copier function, buttons for issuing directives for various operations, and a liquid crystal display.

[0022] As shown in FIGS. 1 and 2, the document reader 2, with the auto sheet feeder 6, is made up of a cover assembly 7, the auto sheet feeder 6, and a reading element 9. The cover assembly 7 is attached to a rear edge of the top surface of the main body case 3 via hinges 8 so as to swing up and down. The auto sheet feeder 6 is provided on one end of a top surface of the cover assembly 7, and the reading element 9 includes a line-type CCD image pickup device, which is arranged at one end of a lower surface of a side-edge 4a of the glass

plate 4. The glass plate 4 is fixed to the upper surface of the main body case 3. In the embodiment, the document reader 2 is structured such that a document is placed face down on the large-sized glass plate 4 and is held by a holding member 7a. The holding member 7a is, for example, a sponge pad provided on a lower surface of the cover assembly 7. Images on the document are read by the reading element 9 that moves on a guide rail 10 disposed along the lower surface of the large-sized glass plate 4 on the basis of an image reading instruction.

**[0023]** With reference to FIGS. 1 to 3, the structure of the auto sheet feeder 6 in the document reader 2 will be described. As shown in FIG. 1, a case portion 11 of the auto sheet feeder 6 is fixed on one end of the cover assembly 7, and a document tray 12 is disposed on one end of the case portion 11 at an inclined angle so that its free end extends upwardly. Below the document tray 12, a discharge paper tray 13 is formed on the top surface of the cover assembly 7 where a document P is discharged.

**[0024]** As shown in FIG. 3, in the case portion 11, a beginning 14a of the upper path plate 14 is located in close proximity to the document tray 12. A separation roller 15 that feeds documents P, while separating them one by one, stacked on the document tray 12, a sheet sensor 16, with a detection lever 16a that pivots by contact with a leading edge of the document P, and a pair of paper feed rollers 17a, 17b are provided on the upper path plate 14. A downward curved end 14b of the upper path plate 14 and a beginning 18a of a lower path plate 18 partially overlap. An end 18b of the lower path plate 18 extends toward ejection rollers 19, 20 arranged proximate the discharge paper tray 13. A pair of conveying rollers 21a, 21b are disposed close to the beginning 18a of the lower path plate 18 at an upstream side of a reading point 23a. A rear sensor 22, with a detection lever 22a, is provided in close proximity to the conveying rollers 21a, 21b. The detection lever 22a detects the leading and trailing edges of a document P to find its length and to determine the occurrence of a paper jam. The lower path plate 18 is curved downwardly in the middle portion with respect to a feed direction, and includes a reading window 23 at its lowest position. The reading window 23 has a rectangular shape, in plan view, and opens above the reading device 9 when at the stop position. The reading window 23 is formed such that a length  $L_o$ , in the sheet feed direction, is short and a length in a direction perpendicular to the sheet feed direction is long (with reference to FIGS. 1 and 3). A plurality of ribs 24 are arranged above the lower path plate 18 with such a narrow spacing that a document P can pass so that a lower surface (from which the image is read) of the document P can slide on a surface of the reading point 23a. A

guide piece 25, that leads the document P passing through the reading point 23a to the downstream side of the upper surface of the lower path plate 18, is fixed to an edge of the side-edge glass plate 4a.

**[0025]** A cover 26 is pivotable about a shaft 27 at its proximal end on one end of the case portion 11 (opposite from the document tray 12), and is structured so as to expose the upper portion of the upper path plate 14 when a paper jam occurs.

**[0026]** The following will describe the structure of the pair of ejection rollers 19, 20, which are a drive roller 19 and a driven roller 20, that function as a sheet feeder on the ejection side of the feed direction with reference to FIGS. 3, 4, and 5. The drive roller 19 and the driven roller 20 are disposed at a downstream side from the reading point 23a. Both the drive roller 19 and the driven roller 20 comprise a plurality of roller segments. The drive roller 19, disposed on an upper side, is fixed to a drive shaft 29 that is parallel to a direction perpendicular to the sheet feed direction (X-axis direction in FIG. 4). The drive shaft 29 is rotated by a drive motor and a transmission gear (not shown) in sheet feed direction. At least a peripheral layer of the drive roller 19 is made from rubber having a large coefficient of friction with respect to the document P. Pairs of segments of the drive roller 19 and the driven roller 20 are provided in a plurality of places on drive shaft 29 and support shafts 30, respectively (four places, or pairs in the embodiment), and symmetrically on each side of a centerline O of the document P with respect to its width (a sheet dimension in Y-axis direction in FIG. 4).

**[0027]** On the other hand, at least a peripheral layer of each segment of the driven roller 20 is made from a synthetic material, such as polyacetal, having a lower coefficient of friction with respect to the document P than that of the segments of the drive roller 19.

**[0028]** To control the sheet feed direction using only the drive roller 19 to prevent sheet skewing, the driven roller 20 preferably has a minimal coefficient of friction. That is, the driven roller 20 must have a coefficient of friction lower than, at least, that of the drive roller 19.

**[0029]** The segments of the driven roller 20 are fitted on a pair of support shafts 30 so as to press against the corresponding segments of drive roller 19. In the embodiment as shown in FIGS. 4 and 5, the segments of the driven roller 20 are arranged symmetrically with two segments on each side of the centerline O and axes 20a of the driven roller 20 segments (axes of the support shafts 30) are arranged so they are not perpendicular to the sheet feed

direction (X-axis direction), i.e., not parallel to the Y-axis direction, but are inclined at an angle of  $\theta$  degrees (1 to 3 degrees in the embodiment, for example and exaggerated in Figure 5A for purposes of illustration) with respect to the Y-axis. The driven roller 20 segments are disposed on a slant such that the driven roller 20 segments close to the centerline O are on the downstream side of the sheet feed direction and the driven roller 20 segments far from the centerline O are on the upstream side (refer to FIG. 5A). The support shafts 30 are supported in guide grooves 31, which are open upwardly in the case portion 11, so as to be movable vertically (FIG. 5B). The support shafts 30 are urged by urging members 33, such as coil springs, plate springs, and elastic members made from rubber, mounted in recessed receiving portions 32 formed adjacent each of the guide grooves 31 so that the driven roller 20 segments are pressed against the drive roller 19 segments (FIG. 5C).

[0030] The guide grooves 31 that support the respective support shafts 30 are formed as pairs and at positions out of alignment such that the inner guide grooves 31 (disposed on a side close to the centerline O) are, with respect to the drive shaft 29, on the downstream side of the sheet feed direction and outer guide grooves 31 (disposed distant from the centerline O) are, with respect to the drive shaft 29, on the upstream side of the sheet feed direction. Thereby, the support shafts 30 are inclined at the angle of  $\theta$  degrees.

[0031] According to the above-described structure, as shown in FIGS. 4 and 6A, a leading edge P1 of the document P, which is conveyed from the upstream side of the sheet feed direction, first collides against nip portions N1, N1 between the drive roller 19 segments and the driven roller 20 segments. The nip portions N1, N1 are closest to the upstream side in the sheet feed direction (FIG. 6A), of the driven roller 20 segments which are arranged on a slant, and contact the leading edge P1 of the document P substantially at points, so that impact is minute. Thus, when the document P is fed from the conveying rollers 21a, 21b and passes through the reading point 23a, and the leading edge P1 of the document P collides against the nip portions N1, N1, the impact (an entry resistance of the leading edge P1) is greatly reduced. The minute impact does not cause phenomena such as the advance of the document P being temporarily stopped, or the document P being bent at the reading point 23a. Thus, the problem that image reading data, at the reading point 23a, is distorted does not occur, and the reading operation can be maintained with stability.

[0032] In an embodiment shown in FIG. 6B, the driven roller 20 segments are arranged symmetrically on both sides of the centerline O, and the axes 20a are arranged on a

slant such that the driven roller 20 segments close to the centerline O are on the upstream side of the sheet feed direction and the driven roller 20 segments far from the centerline O are on the downstream side of the sheet feed direction.

[0033] In an embodiment shown in FIG. 6C, the driven roller 20 segments close to each side of the centerline O are the only segments disposed on a slant so as to be located on the upstream side of the sheet feed direction. The axes 20a of the driven roller 20 segments far from the centerline O are disposed perpendicularly to the sheet feed direction (the X-axis direction), that is parallel to the Y-axis direction.

[0034] The embodiments shown in FIGS. 6B and 6C have the advantage that the leading edge P1 of the document P can be reliably held at the paired nip portions N1 and are of point-contact type even when a width W1 of the document P is small, rather than the larger width shown in FIG. 6A.

[0035] As another embodiment, the drive roller 19 segments may be combined into one or two roller segments that are continuously long in the Y-axis direction, and the plurality of segments of the driven roller 20 may be arranged to press the one or two rollers at intervals. Alternatively, the urging members 33 may be provided for each segment of the driven roller 20 to urge the segments individually.

[0036] Further, of the driven roller 22 segments, the axis 20a of one segment of the driven roller 20 only may be disposed on a slant toward the upstream or downstream side of the sheet feed direction in keeping with the concept of the embodiment.

[0037] As the urging members 33, that urge the driven roller 20 segments into contact with the drive roller 19, are provided on each axis 20a disposed symmetrically with respect to the center of the width of the document, the number of locations of the urging members 33 is decreased and, thus, costs can be reduced.

[0038] If a sheet feed path from a nip portion between the conveying rollers 21a, 21b, located at the upstream side from the reading point 23a, to the nip portion N1 between the ejection rollers 19, 20 located at the downstream side from the reading point 23a is formed to be curved in a top to bottom direction, the document P loses its stiffness compared when a sheet feed path is straight. Thus, when the leading edge P1 of the document P strikes the nip portion N1 between the ejection rollers 19, 20, the document P is likely to stop for a moment or deflect at the reading point 23a because of the impact (the resistance). However, with the above structure, it is possible to prevent problems, such as deflection, from

occurring. Further, in FIG. 3, the direction of the sheet (the document P) may be changed in a path from the reading point 23a to just before the nip portion between the ejection rollers 19, 20 such that the sheet can be substantially parallel to the glass plate 4, and then the leading edge P1 may be inserted into the nip portion. With this structure, the impact at the nip portion can be reduced, thereby preventing the document P, being fed, from deflecting at the reading point 23a. -

[0039] The invention may be applied to not only an auto sheet feeder but also to a sheet ejection part located on a downstream side from a device that feeds sheets (documents P) one by one and executes reading while conveying.